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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/611,395	06/30/2003	Shriram Ramanathan	42P16666	1525

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EXAMINER

BEREZNY, NEMA O

ART UNIT PAPER NUMBER

2813

DATE MAILED: 07/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/611,395

Applicant(s)

RAMANATHAN ET AL.

Examiner

Nema O Berezny

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) 28-42 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-11 and 13-26 is/are rejected.
- 7) ☒ Claim(s) 12 and 27 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>06302003,09022003</u> . | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-27, drawn to a method of making a semiconductor device, classified in class 438, subclass 109.
- II. Claims 28-42, drawn to a semiconductor device, classified in class 257, subclass 777.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the process as claimed can be used to make other and materially different product; for example, the method could fabricate a device without a third and fourth metal layer.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Because these inventions are distinct for the reasons given above and the search required for Group II is not required for Group I, restriction for examination purposes as indicated is proper.

During a telephone conversation with Kerry Tweet on 6-22-04 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-27. Affirmation of this election must be made by applicant in replying to this Office action. Claims 28-42 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2, 5, 7, 13-14, 20, and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Kim (6,380,629). Kim discloses a method comprising: depositing a layer of a metal on a number of conductors disposed on a surface of a wafer; and bonding the conductors of the wafer to corresponding conductors on a surface of a second wafer using the metal layer (col.4 lines 1-15, 39-41) [**claim 1**]. Kim also discloses prior to depositing the metal layer on the conductors, removing dielectric material from the

surface of the wafer (col.4 lines 7-10) **[claim 2]**; wherein the metal comprises one of silver, gold, ruthenium, osmium, iridium, palladium, rhodium, and platinum (col.5 lines 58-60) **[claim 5]**; and wherein depositing the layer of metal on the conductors comprises: forming a blanket layer of the metal over the conductors and the surface of the wafer; and removing the metal from the wafer surfaces (col.4 lines 11-15) **[claim 7]**. Kim also discloses a method comprising: depositing a layer of a first metal on a number of conductors disposed on a first wafer; depositing a layer of a second metal on a number of conductors disposed on a second wafer; aligning the first wafer with the second wafer; and bonding the metal layer on the conductors of the first wafer with the metal layer on the conductors of the second wafer (col.4 lines 1-15, 39-41) **[claim 13]**. Kim also discloses prior to depositing the metal layer on the conductors of the first and second wafers, removing dielectric material from a surface of each of the first and second wafers (col.4 lines 7-10) **[claim 14]**; wherein the first metal and the second metal are the same (col.5 lines 58-60) **[claim 18]**; wherein each of the first and second metals comprises one of silver, gold, ruthenium, osmium, iridium, palladium, rhodium, and platinum (col.5 lines 58-60) **[claim 20]**; and wherein depositing the metal layer on the conductors of each of the first and second wafers comprises: forming a blanket metal layer over the conductors and a surface of the wafer; and removing the blanket metal layer from the wafer surface (col.4 lines 11-15) **[claim 22]**.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-4, 6, 15, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claims 1 and 13 above, and further in view of Shih et al. (6,329,722). Kim does not disclose removing native oxide from the conductors, conductors comprising copper, or bonding at a temperature of 100-300 degrees C. However, Kim would look to one such as Shih for lower resistance, a stronger solderable surface, and lower oxidation of metallic surfaces, respectively.

Shih discloses prior to depositing the metal layer on the conductors, removing native oxide from the conductors (col.3 lines 1-6). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the native oxide removal of Shih with the method of Kim in order to provide lower resistance and therefore a better mechanical bond (an inherent property of native oxide increases resistance) [**claims 3, 15**].

Shih also discloses wherein the conductors comprise copper (col.2 line 65 – col.3 line 1). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the copper conductors of Shih with the method of Kim in order to provide a strong solderable surface (Shih – col.2 lines 28-31) [**claim 4**].

Shih also discloses wherein the bonding of the conductors of the wafer to the corresponding conductors of the second wafer is performed at a temperature between approximately 100 and 300 degrees Celsius (col.5 lines 49-53). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the bonding temperature of Shih with the method of Kim in order to provide less oxidation of the metallic surfaces at a lower temperature (Shih – col.5 lines 59-63) **[claims 6, 21]**.

Claims 8-11, 16-17, and 23-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claims 1 and 13 above, and further in view of Neuhaus et al. (2002/0027294). Kim does not disclose selectively depositing a metal on the conductors comprising a number of islands, or the conductors of the first and second wafers comprising the same metal or comprising copper. However, Kim would look to one such as Neuhaus for reduction of fabrication steps, a better electrical and mechanical bond, and conductors with higher conductivity.

Neuhaus discloses wherein depositing the layer of metal on the conductors comprises selectively depositing the metal on the conductors using one of an electroless plating process, an electroplating process, and a contact displacement plating process (p.4 para.38). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the depositing of Neuhaus with the method of Kim in order to eliminate the fabrication steps of patterning, etching, and

removing of material which is required for conventional deposition and patterning of conductors **[claims 8, 9, 23, 24]**.

Neuhaus discloses wherein the metal layer on each of the conductors comprises a number of islands which are selectively deposited on the conductors (p.4 para.50; p.6 para.64). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the metal layer island deposition of Neuhaus with the method of Kim in order to pierce the conductors and form a stronger bond (Neuhaus – p.5 para.57) **[claims 10, 11, 25, 26]**.

Neuhaus discloses wherein the conductors of each of the first and second wafers comprise the same metal (p.4 para.51). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the same metal for conductors of the first and second wafers of Neuhaus with the method of Kim in order to perform the same fabrication step of conductor deposition for both wafers **[claim 16]**.

Neuhaus discloses wherein the conductors of each of the first and second wafers comprise copper (p.3 para.28). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use copper metal for conductors of the first and second wafers of Neuhaus with the method of Kim in order to provide conductors of high conductivity (inherent property of copper) **[claim 17]**.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claim 13 above, and further in view of DiStefano (6,324,754). Kim does not disclose the first and second metals being different. However, Kim would look to one

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such as DiStefano for centering solder balls because DiStefano discloses wherein the first metal and the second metal are different (col.6 lines 51-64; col.10 lines 66-67).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use different metals for the first and second metals of Neuhaus with the method of Kim in order to provide centering of the solder balls upon the first and second metals (col.10 lines 66-67).

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter, regarding claims 12 and 27: the prior art of record does not teach or disclose or make obvious depositing a blanket layer of metal over conductors and the surface of the wafers, and removing said metal layer from the wafer surface and from portions of each conductor to form a number of islands on each conductor. Neuhaus discloses forming conductive particles or islands to conductors, but not by a subtractive method (p.4 para.38, 50; p.6 para.64).

Claims 12 and 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

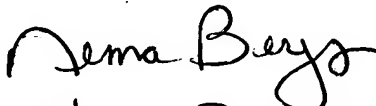
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nema O Berezny whose telephone number is (571) 272-1686. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NB


Nema Berezny